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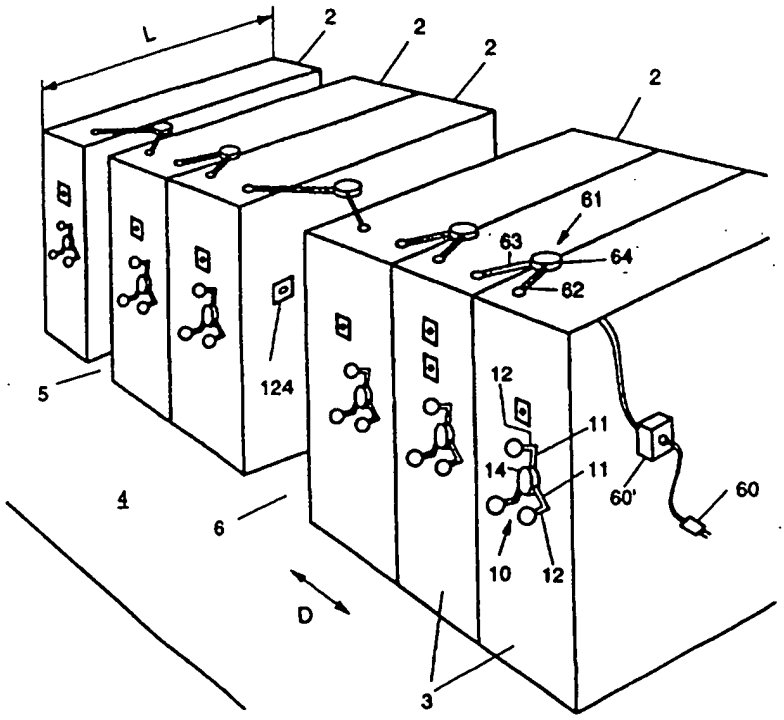
(54) Title: STORAGE SYSTEM AND DEVICE FOR ENSURING THE SAFETY OF A STORAGE SYSTEM

(57) Abstract

Described is a storage system (1) with mobile storage units (2), the safety of use of which is increased by the presence of a freewheel clutch (40) in each storage unit (2). Normally, that clutch is disengaged. Only if it is checked that the passageways (6) are free, is the clutch engaged by a central control unit (101). Preferably, only the coupling of a crank (10) operated by the user is then engaged, which engaged coupling is preferably a slip clutch (40).



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Title: Storage system and device for ensuring the safety of a storage system

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The invention relates to a storage system comprising mobile storage units. Such a system is known in practice and renders it possible to utilize the storage capacity, that is to say the floor surface, of a storage space in a very efficient manner.

To put away or store articles, such as, for instance, files in a filing department or spare parts in a warehouse, it is known to use elongated storage units, such as racks or cabinets, which, for instance, comprise a frame of side walls and a multiplicity of horizontal shelves for placing the articles thereon. To enable placing or removing the articles, the cabinets must be accessible via passageways between the cabinets. A filing space filled with stationary cabinets will then be occupied with alternate storage cabinets and passageways. A drawback of the use of stationary cabinets is the necessary presence of a passageway for each cabinet, because the passageway itself cannot be used for storage purposes. In other words, the presence of a passageway means that a storage space can be used less efficiently.

To reduce this drawback, storage systems have been introduced in which the storage units are provided at their bottom sides with wheels so as to be movable transversely to their longitudinal direction. If a specific storage unit must be made accessible, the storage units are moved to create a passageway beside the relevant storage unit. Thus, the number of storage units that can be placed side by side in a storage space is considerably increased.

To move the storage units two different driving principles have been developed. A first driving principle is a motor drive: each storage unit is provided with an electric motor, and the driving motors of all the storage units to be moved are operated via a single control button. Such a system gives much ease of operation, but is relatively expensive.

A second driving principle is manual driving, and the present invention relates to a storage system with mobile storage units to be moved by manual effort. In such a system the storage units are provided at their front walls with a crank coupled to a gear wheel which engages a gear rack mounted in the floor. By rotating a crank a user can move a storage unit, as well as the adjacent storage units, in the direction of movement.

An important aspect of such storage systems with mobile storage units is safety.

A first safety aspect is concerned with the presence of persons in the passageway. It will be clear that when a storage unit is made accessible by creating a passageway beside that storage unit by moving adjacent storage units, these moving storage units will close an earlier present passageway, which may be dangerous for any person being present in that former passageway. In this connection it is to be considered that the loaded storage units may have a high weight, which weight may be even 10 tons in practice. Of course, the user of the storage system, that is to say the person moving the storage units, must always make sure that the former passageway is free. In known systems, reliance is placed on the discipline of the users that they actually carry out such a check. In practice, however, this is omitted owing to forgetfulness or carelessness. It is therefore a first object of the present invention to improve the safety of a storage system in this regard.

A second safety aspect is concerned with the crank. As stated before, the crank is coupled to a gear wheel which engages a gear rack mounted in the floor, so that the storage unit can be moved by rotating the crank. Conversely, however, the crank will also rotate when the storage unit is moved in a different way, for instance, when pushing against that storage unit by rotating the crank of another storage unit. That rotating crank of a moving storage unit may touch a nearby person and cause damage. It is therefore a second

object of the present invention to improve the safety of a storage system in this regard. More in particular, the present invention aims at providing a storage system in which the cranks of moving storage units do not rotate.

A third safety aspect is also concerned with the crank. When a user exerts a force on a crank to rotate the above gear wheel, the coupling members between the crank and the gear wheel will be elastically deformed, during which a certain amount of elastic energy is stored in that deformation. When the user releases the crank so that no force can be exerted thereon any longer, the above elastic energy will be set free, thus rotating back the crank. The stored amount of elastic energy depends on the precise construction of the above coupling members, on the weight of the storage unit, on the frictional forces, etc. In specific cases, that amount of energy can be so large that the crank when released by the user rotates back over a relatively great distance and with much force, which is experienced by the user as a recoil and is at least unpleasant, but may even lead to injuries. It is therefore a third object of the present invention to improve the safety of a storage system in this regard. More in particular, the present invention aims at providing a storage system in which the amount of elastic energy that can be stored in the driving system is limited.

The present invention also aims at providing an improvement in the esthetic sphere. As stated before, the crank is driven for rotation by moving storage units. This implies that in any situation, that is to say in any position of the different storage units, the different cranks may have any position of rotation, which may be mutually different for the different cranks, which is undesirable, if only from an esthetic point of view. It is therefore a further object of the present invention to provide a storage system which ensures that all the non-operated cranks will always take the same position of rotation.

The present invention also aims at providing an improvement in the ergonomic sphere. As stated before, one or several storage units are moved by rotation of the crank. Although the movement to be transferred by the crank is a rotation, the force to be exerted by the user on the end of the crank is a linear force, and the direction of that linear force depends on the position of the crank. Therefore, it makes much difference to the user whether the crank is directed upwardly, downwardly or horizontally. The greatest force the user must exert is required when the storage unit must be moved from a standstill. The user will find the least difficulty in exerting a great driving force if that force can be exerted in horizontal direction, preferably at shoulder height, and preferably in the direction of the desired movement of the storage unit. It is therefore a further object of the present invention to increase the ease of operation in this regard.

According to a first important aspect of the present invention the storage system is provided with a control unit, impeding means controlled by the control unit, normally impeding a movement of storage units, and releasing means for releasing a movement of storage units, which releasing means supply a signal to the above control unit which, in response to that signal, controls the impeding means to allow the above movement.

According to a further important aspect of the present invention the crank is provided with a disengageable slip clutch. Normally, the clutch is disengaged; under control of the above control unit, however, the slip clutch is engaged, the maximally transferable force being limited to the slip value of the slip clutch.

These and other aspects, features and advantages of the present invention will be explained by the following description of a preferred embodiment of a storage system according to the invention, with reference to the accompanying drawings, in which:

Fig. 1 is a diagrammatic perspective view of a storage system with mobile storage units;
Fig. 2 is a diagrammatic cross-sectional view of a storage unit;
Fig. 3 is a cross-sectional view, comparable with Fig. 2, of a variant of a storage unit;
Fig. 4 is a diagrammatic view of a circuit of a freewheel clutch controlled by a control unit;
Figs. 5A-D illustrate details of a crank, Fig. 5A being a front view, and Figs. 5B-D being cross-sectional views;
Fig. 6 is a circuit diagram of safety means 100 for a storage unit;
Fig. 7 is a circuit diagram of releasing means 120 for a storage unit; and
Fig. 8 is a variant of embodiment of releasing means 120.

Fig. 1 is a diagrammatic perspective view of a storage system 1 with mobile storage units 2, six of which are shown in Fig. 1. Each storage unit 2 is substantially block-shaped, the storage units 2 being arranged parallel to each other, parallel to their larger dimension, which is designated as length L. On their bottom sides the storage units 2 are provided with wheels, which is not shown in Fig. 1, so that they are movable in a direction D perpendicular to their longitudinal direction. Located between two successive storage units 2 is an interspace 5, the dimension of which may vary in the direction of movement D. As illustrated on the right-hand side of Fig. 1, adjacent storage units 2 may touch each other, with their front walls 3 forming a substantially continuous front which forms a side wall of a main passageway 4. The dimensions of the interspaces 5 are then zero. As illustrated on the left-hand side of Fig. 1, adjacent storage units 2 need not touch each other, but the interspace 5 may exceed zero. If that interspace 5 is sufficiently broad, so that it is readily accessible to a

person, that interspace 5 can be designated as a passageway 6, as illustrated in the middle of Fig. 1.

Provided at the front wall 3 of each storage unit 2 is a crank 10. The crank 10 is coupled to a gear wheel 23 (Fig. 2), so that a user present in the main passageway 4 can move a storage unit 2 by rotating the crank 10. To this end, the crank 10 has an arm 11 being substantially at right angles to its rotary shaft 13, or otherwise directed in an inclined forward position, which arm 11 has a gripping end 12, for instance in the form an axially directed handle (see also Fig. 5). The crank 10 is shown in Fig. 1 as a three-armed crank, that is to say the crank 10 has three of such arms 11, which mutually always include angles of 120°; such a construction of the crank 10 has the advantage that always at least one arm 11 is located above the rotary shaft 13 of the crank 10.

Fig. 2 shows a diagrammatic longitudinal section of a storage unit 2. The storage unit 2 has a frame 30 with wheels 21 mounted therein for rotation and moving on guide rails 7 arranged on the floor, parallel to the front wall 3. The storage unit 2 is further provided movement driving means 20 for manually driving a movement of the storage unit 2 along the guide rails 7. These movement driving means 20 comprise a shaft 22 fitted in the frame 30 for rotation and having a gear wheel 23 mounted thereon, which engages a gear rack 8 likewise mounted on the floor. The movement driving means 20 further comprise a first sprocket wheel 24 connected via a chain 25 to a second sprocket wheel 26 which is mounted on a sprocket wheel shaft 27 fitted in the frame 30 for rotation and aligned with the rotary shaft 13 of the crank 10.

According to the state of the art the crank 10 and the second sprocket wheel 26 are rigidly connected together, because the sprocket wheel shaft 27 is integral with the rotary shaft 13 of the crank 10. In an important embodiment of the storage system according to the present invention,

however, a slip clutch 40 is interposed between the crank 10 and the second sprocket wheel 26, which slip clutch 40 consists of two coupling halves 41 and 42, which are pressed together with a predetermined force by means which, for simplicity's sake, are not shown in Fig. 2, a first coupling half 41 being rigidly fitted relative to the crank 10, and the second coupling half 42 being rigidly fitted relative to the second sprocket wheel 26. It is to be noted that slip clutches are known per se, for instance in the form of friction plates, and that known per slip clutches may be used, for which reason the construction of the slip clutch 40 need not be discussed in more detail.

Through the presence of the slip clutch 40 the force the user can transfer via the coupling means 26, 25, 24, 22, 23 to the gear rack 8 is limited to a predetermined level. When the user exerts a force exceeding that predetermined level, the slip clutch 40 will slip. Consequently, it is achieved in a relatively simple manner that the amount of elastic energy in the coupling means 26, 25, 24, 22, 23, for instance in the form of elastic stretch of the chain 25 and/or torsion of the shaft 22, is limited, thus removing or at least reducing the earlier mentioned rebounding effect that may occur in known storage systems.

Reference is now made to Fig. 3, which shows an embodiment of a storage unit comparable with the embodiment shown in Fig. 2, except that the slip clutch 40 is replaced by an electronically controlled freewheel clutch 50. Fig. 4 is a functional circuit diagram of the freewheel clutch 50. The freewheel clutch 50 comprises two coupling halves 51 and 52 which normally do not engage each other and can be caused to engage each other under control of a control unit 53. Once engaged, the two coupling halves 51 and 52 are comparable with the earlier discussed coupling halves 41 and 42, with the proviso that the two coupling halves 51 and 52 need not

be constructed as a slip clutch, although that is preferred for the reasons discussed before.

The freewheel clutch 50 further comprises a rotation detector 54 associated with the crank 10, more in particular with the rotary shaft 13 of the crank 10, to detect a rotation of the crank 10, and to supply to the control unit 53 a signal indicative of any rotation of the crank 10. The rotation detector 54 may be any detector suitable for the above purpose, as will be clear to a skilled person. By way of example, mention is made here of a Hall sensor or a combination of a photodetector (light lock) with a perforated or toothed disk mounted on the rotary shaft 13 of the crank 10.

The operation is as follows. Normally, the coupling halves 51, 52 do not engage each other. Consequently, when the storage unit 2 is moved by external causes, for instance because a adjacent storage unit 2 is driven, the crank 10 will remain stationary. This has the advantage of eliminating the risk of a rotating crank accidentally touching somebody. When, however, the crank 10 is rotated by an operating person, the detector 54 will detect this rotation and supply a signal to the control unit 53, which is arranged to energize, in response to receiving the above signal, pressing means 55 for the coupling halves 51, 52 so as to cause the coupling halves 51, 52 to engage each other.

The pressing means 55 may be any means suitable for the purpose, for instance based on an electromagnet, as will be clear to a skilled person. Besides, it is to be noted that the nature and construction of the electrically energizable coupling 51, 52, 55 is no subject of the present invention and knowledge thereof is not required for a skilled person to properly understand the present invention. Since, furthermore, electrically energizable couplings are known per se and are commercially available, which standard couplings are very useful in a storage unit 2 according to the present

invention, the construction of the electrically energizable coupling 51, 52, 55 will not be described in more detail.

The control unit 53 is arranged to maintain the energization of the pressing means 55, as long as the crank 10 rotates, and to remove that energization immediately when or a predetermined retardation time, for instance 5 seconds, after the signal of the detector 54 indicates that the crank 10 stands still.

The control unit 53 may comprise a suitably programmed computer or microprocessor or microcontroller, as will be clear to a skilled person.

It will be clear that an electric power source is required for the functioning of the control unit 53 and the energization of the pressing means 55. In principle, a power source, such as, for instance, a battery or a connection to the mains, may be associated with each storage unit 2. Preferably, however, as illustrated in Fig. 1, the storage system 1 is provided with a central mains connection 60, and all the storage units 2 are connected to that central mains connection 60, if required by means of a transformer 60'. A feed cable may connect the adjacent storage units 2, which feed cable may be freely suspended between the adjacent storage units 2 in the form of loops, but is preferably guided in a scissors bridge 61, which comprises two open or closed tubes 62, 63. First ends of the tubes 62, 63 are pivoted to adjacent storage units 2, the other ends of the tubes 62, 63 meeting each other at a pivot box 64. Such a scissors bridge 61 is known per se.

Fig. 1 shows the crank 10 as a three-armed crank. Preferably, however, the crank is a one-armed crank, as illustrated in Figs. 5A and 5B. This has different advantages. First, the user operating an arm of a three-armed crank, can be hindered by the two other arms of that crank; this drawback is absent in case of a one-armed crank. Second, in a one-armed crank the center of gravity will generally not

be in line with the rotary shaft 13, so that such a one-armed crank, when combined with a freewheel clutch 50, will tend to take a vertical position under the action of gravity. This implies that all the cranks of all the storage units will have the same orientation, which is considered an advantage from an esthetic point of view.

When the user releases the one-armed crank 10 in any non-vertical position, the crank 10 will remain in this position as long as the control device 53 maintains the energization of the pressing means 55, and the crank 10 will begin to move under the action of gravity to a vertical orientation at the moment when the control device 53 eliminates the energization of the pressing means 55. The rotation of the crank 10 resulting at that moment is detected by the detector 54, and in response thereto the control device 53 could energize the pressing means 55 again, following which the just started rotation of the crank 10 stops again. The result would be that the crank 10 moves only slowly and stepwise to a vertical orientation. This effect is considered undesirable. Consequently, the control device 53 is preferably arranged to maintain, after termination of the energization of the pressing means 55, this non-energized condition for a predetermined time, and to respond again to any signal of the detector 54 only after the lapse of that predetermined time.

In principle, there are two possibilities for combining the direction of rotation of a crank 10 and the direction of movement of a storage unit 2. Users, however, experience it as a matter of course when a clockwise direction of rotation (viewed from the user) results in a movement to the right (also viewed from the user). Moreover, it is pleasant to the users if the force to bring a storage unit 2 from a standstill into movement can be exerted in the direction of movement, in which the user preferably holds his arm substantially horizontally. This implies that it is desirable that a one-armed crank is directed substantially vertically

upward when a storage unit 2 is brought from a standstill into movement. The present invention provides two solutions to this objective.

First, the control device 53 may be arranged to energize the pressing means 55 not immediately after receipt of the rotation-indicating signal from the detector 54, but only when the arm 11 of the crank 10 is directed substantially vertically. To this end, the control device 53 may be arranged to process the signal from the detector 54 for calculating a traveled angle of rotation. The crank 10 may also be provided with a position detector 56 arranged to supply a signal to the control device 53 when the direction of the arm 11 is within a predetermined range of values. Such a position detector may comprise, for instance, a combination of a segment of a circle and a light lock, as will be clear to a skilled person. A preferred range from said range of angle values is about 135° - 225°, but more preferably about 160° - 200°.

The above-described construction may be used in an embodiment in which the crank 10 in the resting position (i.e. the non-energized condition of the pressing means 55) has a vertically downward orientation. This implies an embodiment in which the center of gravity of the crank 10 is on the arm side of the rotary shaft.

Second, the crank 10 may be arranged, by way of alternative, to assume in the resting position a vertically upward orientation, which implies that the center of gravity is opposite the arm side of the rotary shaft. Figs. 5B-5D illustrate embodiments thereof. The crank 10 has an arm 11 with a handle 12 at the free end thereof, while the other end of the arm 11 is fixed to a central body 14. The central body 14 may have any form, but preferably has a symmetrical form, for instance the form of a regular polygon, but preferably a circular form, as illustrated. Fixed to the central body 14 is the rotary shaft 13 of the crank 10. The crank 10 is of such construction that the mass center,

relative to the rotary shaft 13, is opposite the handle 12, in line with the arm 11. To this end, for instance, the handle 12, the arm 11 and the part 14' of the central body 14 located on the side of the arm 11 up to the rotary shaft 13 may be manufactured from a relatively light material, for instance plastic, while the part 14" of the central body 14 is manufactured from a relatively heavy material, for instance solid steel. The rotary shaft 13 may also be eccentrically fixed to the central body 14, as illustrated in Fig. 5C, or even to the arm 11, as illustrated in Fig. 5D, so that the central body 14 performs the function of a counterweight. Combinations thereof are of course also possible.

It is to be noted that preferably each storage unit 2 is provided with an associated control unit 53, but that it is also possible that a control unit 53 common for several storage units is present.

Now reference is made again to Fig. 1. When a user wishes to gain access to the second storage unit 2 (viewed from the left-hand side in Fig. 1), he shall wish to broaden the interspace 5 between the first and second storage units. To this end, he shall operate the crank 10 of the second storage unit 2 to move the second storage unit 2 to the right, while the third storage unit 2 is likewise moved to the right, so that the passageway 6 now present between the third and fourth storage units is closed. It will be clear that this involves a danger factor: when somebody is present in the passageway 6, he will run the risk of being wedged. To avoid this, the user must check whether the passageway 6 is free. The safe use of known storage systems therefore depends on the checking discipline of the users.

According to a particular aspect of the present invention the safety of the storage system 1 less depends on the human factor, for the invention provides a storage system 1 with safety means 100 arranged to allow a movement

of storage units only if it has been checked whether this can be done safely.

Fig. 6 shows a block diagram of the storage system 1 with the safety means 100. The safety means 100 comprise a central control unit 101. Associated with each storage unit 2 are locking means 110 which normally impede a movement of the storage units 2, and which are controlled by the central control unit 101. Associated with each interspace 5 are releasing means 120 which supply to the central control unit 101 a signal regarding the condition of the relevant interspace 5, which signal is either indicative of "safe" or is indicative of "unsafe". The central control unit 101 controls the locking means 110 on the basis of the signals received from the releasing means 120: if an "unsafe" signal is received from one of the releasing means 120, the locking means 110 remain locked.

With reference to Figs. 3 and 4, possible embodiments of the locking means 110 will now be discussed.

In a conceivable embodiment the locking means 110 comprise a mechanical lock, such as, for instance, a mechanical brake or a locking pawl, associated with the movement driving means 20, as will be clear to a skilled person. For simplicity's sake, this embodiment of the locking means is not illustrated separately.

Preferably, however, the locking means 110 comprise for each storage unit 2 a freewheel clutch 50 associated with the crank 10. The freewheel clutch 50 may be identical with the freewheel clutch 50 as described above and as illustrated in Figs. 3 and 4, except that in this case the freewheel clutch 50 is a controllable freewheel clutch. To simplify the discussion of an example of embodiment, it will be assumed that each storage unit 2 has a control unit 53, identical with the control unit 53 discussed above, but provided with a command input 57, as shown in Fig. 4, which command input 57 is connected to a command output 102 of the central control unit 101. It is also possible, however, that the task of the

different individual control units 53 is adopted by the central control unit 101, in which case, therefore, no separate control units 53 need to be present.

The central control unit 101 is arranged to supply to the control unit 53 a command signal which can represent two conditions. The control unit 53 is arranged to function as described above on receipt of a command signal representing a first condition, indicated as releasing condition, and to leave the pressing means 55 non-energized at any time on receipt of a command signal representing a second condition, indicated as locking condition, irrespective of whether the crank 10 rotates or not. Consequently, a storage unit 2 cannot be moved by means of rotation of its crank 10 as long as a signal representing a locking condition, indicated as locking signal, is transmitted to the storage unit 2 by the central control unit 101.

With reference to Fig. 7 ff., possible embodiments of the releasing means 120 will now be discussed.

The releasing means 120 are present at each interspace 5 and may have different embodiments, examples of which will be discussed below. It is to be noted that per interspace several types of embodiments may be present in combination.

In a first embodiment the releasing means 120 comprise for each interspace 5 an electrically conductive wire piece or chain 121, the ends of which are coupled to always two electric terminals 122, 123 of two adjacent storage units 2. All the terminals 122, 123 can be separately coupled to the central control unit 101, but preferably the terminals 122, 123 of one storage unit 2 are connected together, so that all the wire pieces 121 are connected in series, so that for all the wire pieces 121 the central control unit 101 only needs to have two terminals in total, irrespective of the number of storage units 2, only three of which are shown in Fig. 7.

The operation of this embodiment is as follows. Normally, all the wires 121 form a closed circuit, which is

detected by the central control unit 101, in response to which the central control unit 101 supplies a releasing signal. When a user wishes to enter a passageway, he meets the wire 121 associated with that passageway and preventing access to the passageway. To enable him to enter the passageway, the user must disconnect that wire, which is detected by the central control unit 101 as an interruption of the closed circuit at its terminals, in response to which the central control unit 101 supplies a locking signal to all the locking means 110.

In a second embodiment the releasing means 120 comprise in each passageway a presence detector which actively detects whether a person is present in that passageway and supplies a detection signal to the central control unit. An example of such a detector is a weight sensor arranged in the floor, which supplies a detection signal when a weight is present thereon, or a movement detector based on infrared radiation.

The invention provides an embodiment preferred because of simplicity and low cost. In this preferred embodiment each storage unit 2 is provided with a contact switch 124 (see Fig. 8), for instance in the form of a push button to be operated by the user. Each contact switch 124 is preferably positioned at a lateral part of the associated storage unit 2, that is to say in the interspace 5, at a distance of preferably about 1 meter from the front wall 3.

It will be clear that an interspace 5 only needs to be actively checked by the user if the dimension thereof is large enough to form a passageway 6. The releasing means 120 of the system according to the present invention are therefore preferably of such construction that they automatically supply a "safe" signal to the central control unit 101 if the distance between two storage units 2 is smaller than a predetermined threshold distance. It will be clear that between two storage units touching each other there is no passageway to be checked. But also when the interspace 5 between two adjacent storage units is smaller

than a predetermined threshold distance, for instance 25 cm, a check is superfluous.

Fig. 1 shows that two adjacent storage units 2 are connected by a scissors bridge 61, the two arms 62, 63 of which form an angle related to the mutual distance between the two storage units 2. The scissors bridge 61 is provided with a switch 125 which detects whether the angle between the scissors arms 62, 63 is larger than a predetermined angle, which indicates that the relevant interspace 5 must be checked.

The operation of this embodiment is as follows. Normally, the central control unit 101 supplies a locking signal to all the locking means 110. Only if the user operates the contact switch in the passageway 6, the central control unit 101 supplies an approval signal for a predetermined time, for instance 15 seconds. The approval signal is maintained when the user operates a crank 10 within the above predetermined time. The approval signal disappears when the user does not operate a crank within the above predetermined time, or when the user interrupts the operation of a crank for a longer time than a second predetermined time, for instance 5 seconds.

This embodiment has in common with the conventional system that the user must check the passageway 6 for the presence of persons (or other obstacles). As stated before, it could occur in the conventional system that a user forgot such a check. In the embodiment now proposed, however, the user is forced to go to the passageway in order to operate the relevant contact switch 124, which automatically involves a check on the passageway.

In a possible embodiment all the scissors arm switches 125 and all the contact switches 124 are individually connected to the input 103 of the central control unit 101. This means, however, that the central control unit 101 must have a relatively large number of input

connections, which number is proportional to the number of storage units.

In another possible embodiment, illustrated in Fig. 8, the scissors arm switch 125 and the contact switch 124 are connected in parallel for each interspace 5, while, furthermore, all those parallel combinations of all the interspaces 5 are connected in series, which series connection is connected to two input connections of the central control unit. Thus, a detection loop is defined, comparable to the circuit of Fig. 7. Each scissors arm switch 125 forms a closed contact if the arms 62, 63 of the relevant scissors bridge 61 form an angle smaller than the threshold angle, so that only for the interspaces 5 to be checked an open contact is present, which will be closed by operating the relevant contact switch 124.

In a system with a relatively large amount of storage units 2 the number of interspaces 5 to be checked may be rather large. To indicate a "safe" condition, all the relevant contact switches must be closed simultaneously. This can be solved by providing each contact switch 126 with a retaining circuit 126, which, after the operation, retains the closed condition of the contact switch 124 for, for instance, 15 seconds to enable the operation of several contact switches 124, as will be clear to a skilled person.

It will be clear to a skilled person that it is possible to change or modify the illustrated embodiments of the device according to the invention, without departing from the inventive concept or the scope of protection as defined in the claims.
Thus, for instance, it is possible that the construction of the movement driving means for the storage units differs from the illustrated construction.

It is further pointed out that in the above, for convenience's sake, reference has been made to interspaces 5 or passageways 6 to be checked, located between the storage

units 2. It may be clear that the same considerations apply to the space outside the outer storage units, which will generally be a space between a storage unit and a wall, and that such spaces may also be provided with the safety means according to the present invention.

Claims

1. A mobile storage unit (2) for a storage system (1), comprising:
a frame (30);
a front wall (3);
a rotary shaft (13) extending through the front wall (3) and arranged in the frame (30), with a crank (10) mounted thereon;
movement driving means (20) coupled to said crank (10) and arranged to move the storage unit (2) during rotation of the crank (10);
characterized in that the crank (10) is coupled to the movement driving means (20) by means of an electronically controlled freewheel clutch (50), said freewheel clutch (50) comprising:
- two coupling halves (51, 52), which normally do not engage each other;
- electrically energizable pressing means (55) arranged to engage the coupling halves (51, 52) with each other during energization;
- a rotation detector (54) associated with the crank (10) and arranged to detect a rotation of the crank (10) and to supply a signal indicative to such a rotation; and
- a control unit (53) for receiving said signal from the rotation detector (54), said control unit (53) being arranged to energize said pressing means (55) in response to the receipt of said signal.

2. A mobile storage unit according to claim 1, wherein the control unit (53) is arranged to maintain the energization of the pressing means (55) as long as the crank (10) rotates, and to remove said energization immediately when or a predetermined retardation time after the signal from the detector (54) indicates that the crank (10) stands still.

3. A mobile storage unit according to claim 1 or 2, wherein the control unit (53) is arranged to maintain, after termination of the energization of the pressing means (55), said non-energized condition for a predetermined time and to respond again to any signal from the detector (54) only after the lapse of said predetermined time.

4. A mobile storage unit according to any of claims 1-3, wherein the two coupling halves (51, 52) are a slip clutch.

5. A mobile storage unit according to any of claims 1-4, wherein the crank (10) is a one-armed crank.

6. A mobile storage unit according to claim 5, wherein the crank (10) has a vertically downward orientation in the resting position, and wherein the control device (53) is arranged to energize the pressing means (55) only if, after receipt of the rotation-indicating signal from the detector (54), the arm (11) of the crank (10) is substantially vertically directed.

7. A mobile storage unit according to claim 6, wherein the control device (53) is arranged to process the signal from the detector (54) to calculate a traveled angle of rotation.

8. A mobile storage unit according to claim 6 or 7, wherein the crank (10) is provided with a position detector (56) arranged to supply a signal to the control device (53) when the direction of the arm (11) is within a predetermined range of values, preferably within the range of about 135° - 225°, more preferably within the range of about 160° - 200°.

9. A mobile storage unit according to claim 5, wherein the crank (10) is arranged to assume a vertically upward orientation in the resting position.

10. A mobile storage unit according to claim 9, wherein the crank (10) has a rotary shaft (13) and an arm (11) directed transversely to the rotary shaft (13) with a handle (12) at the free end thereof, the center of gravity of the crank (10) being, viewed from the rotary shaft (13), opposite said arm (11).

11. A mobile storage unit according to claim 9, wherein the crank (10) has a central body (14), and wherein the rotary shaft (13) is eccentrically fixed to the central body (14).

12. A mobile storage unit according to claim 9, wherein the arm (11) is extended beyond the rotary shaft (13), and wherein a counterweight (14) is fixed to the extension of the arm (11).

13. A crank (10) for a mobile storage unit (2), comprising a rotary shaft (13) and an arm (11) directed transversely to the rotary shaft (13) with a handle (12) at the free end thereof, the center of gravity of the crank (10) being, viewed from the rotary shaft (13), opposite said arm (11).

14. A storage system (1), comprising a multiplicity of mobile storage units (2), each mobile storage unit (2) comprising:
a frame (30);
a front wall (3);
a rotary shaft (13) extending through the front wall (3) and arranged in the frame (30), with a crank (10) mounted thereon;
movement driving means (20) coupled to said crank (10) and arranged to move the storage unit (2) during rotation of the

crank (10);

characterized by:

- locking means (110) associated with each storage unit (2) for normally locking the movement of the storage units;
- releasing means (120) associated with each interspace (5) between two adjacent storage units (2);
- a central control unit (101), an output (102) of which is coupled to the locking means (110) and an input (103) of which is coupled to the releasing means (120); the releasing means (120) being arranged to supply to the control unit (101) a signal indicating whether the relevant interspace (5) is safe, and the control unit (101) being arranged to remove the locking effect of the locking means (110) when the signals from the releasing means (120) received at the input (103) indicate that all the interspaces (5) are safe.

15. A storage system according to claim 14, wherein the releasing means (120) comprise detectors or sensors.

16. A storage system according to claim 14, wherein the releasing means (120) comprise an electrically conductive chain or wire (121) connected to terminals (122, 123) of adjacent storage units (2).

17. A storage system according to claim 14, wherein the releasing means (120) comprise an operable switch contact (124).

18. A storage system according to any of claims 14-17, wherein all the releasing means (120) are connected in series.

19. A storage system according to any of claims 14-18, wherein the releasing means (120) comprise means (61, 125)

supplying a signal indicative of the width of an interspace (5).

20. A storage system according to claim 19, wherein the releasing means (120) comprise a scissors bridge (61) with legs (62, 63) and a switch (125) coupled to said scissors bridge (61).

21. A storage system according to any of claims 14-20, wherein the locking means (110) comprise a controllable brake or lock.

22. A storage system according to any of claims 14-20, wherein the crank (10) is coupled to the movement driving means (20) by means of an electronically controlled freewheel clutch (50), said freewheel clutch (50) comprising:

- two coupling halves (51, 52) which normally do not engage each other;
- electrically energizable pressing means (55) arranged to engage the coupling halves (51, 52) with each other during energization;

said control device (101) being arranged to generate a control signal for the coupling halves (51, 52) in a manner such that the engagement of the coupling halves (51, 52) can be effected only if all the passageways are found safe.

23. A storage system according to claim 22, wherein the output (102) of the control device (101) is coupled to the electrically energizable pressing means (55) and is arranged to engage all the coupling means (55) when all the passageways are found safe.

24. A storage system according to claim 22, wherein the electrically energizable pressing means (55) are provided with:

- a rotation detector (54) associated with the crank (10)

and arranged to detect a rotation of the crank (10) and to supply a signal indicative of such a rotation;

- a control unit (53) for receiving said signal from the rotation detector (54), said control unit (53) being connected to the output (102) of the central control unit (101) and being arranged to energize said pressing means (55) when said signal is received from the rotation detector (54) and when an approval signal is received from the central control unit (101).

25. A mobile storage unit (2) for a storage system (1), comprising:

a frame (30);

a front wall (3);

a rotary shaft (13) extending through the front wall (3) and arranged in the frame (30), with a crank (10) mounted thereon;

movement driving means (20) coupled to said crank (10) and arranged to move the storage unit (2) during rotation of the crank (10);

characterized in that the crank (10) is coupled to the movement driving means (20) by means of a slip clutch (40).

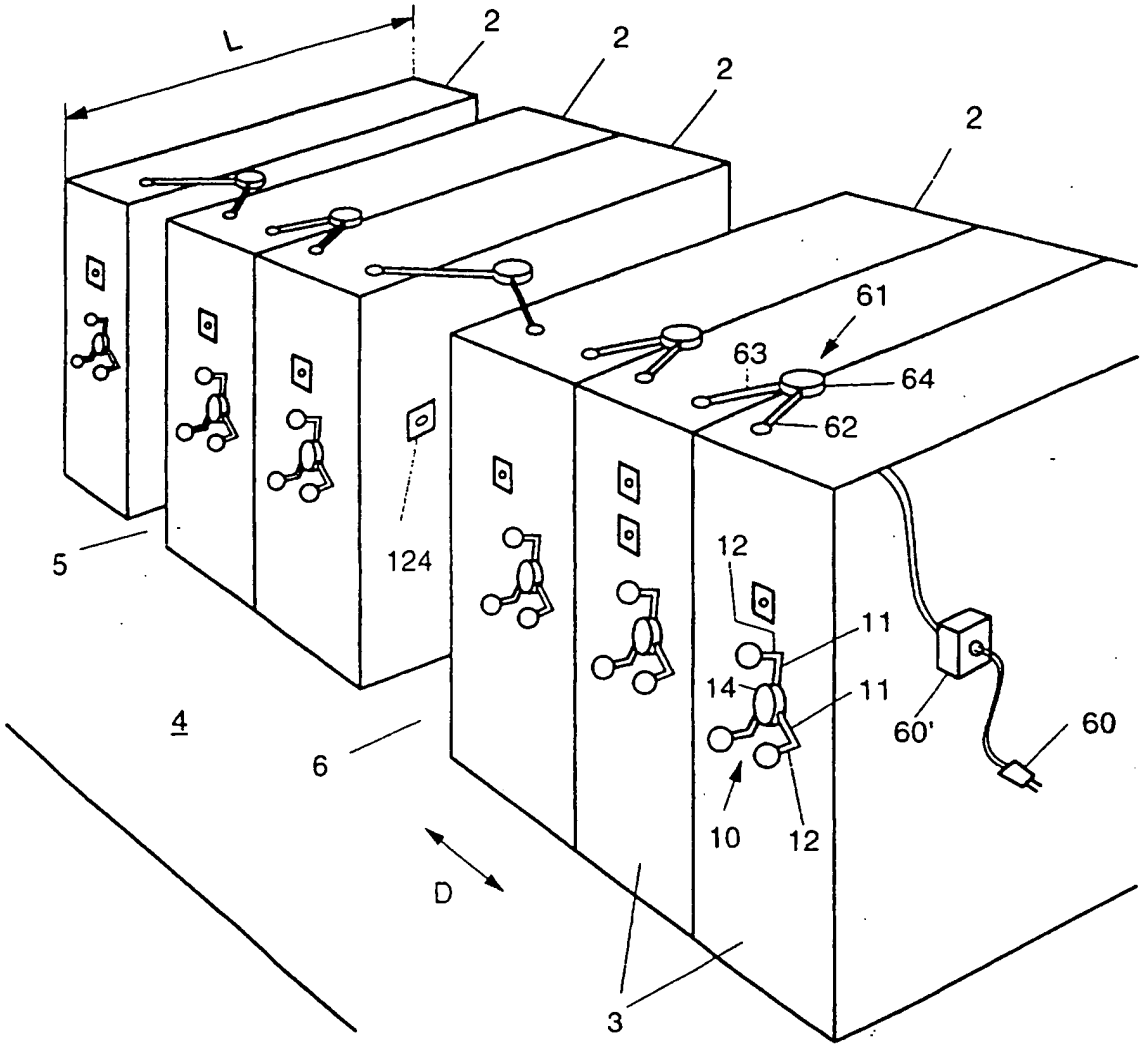


FIG. 1

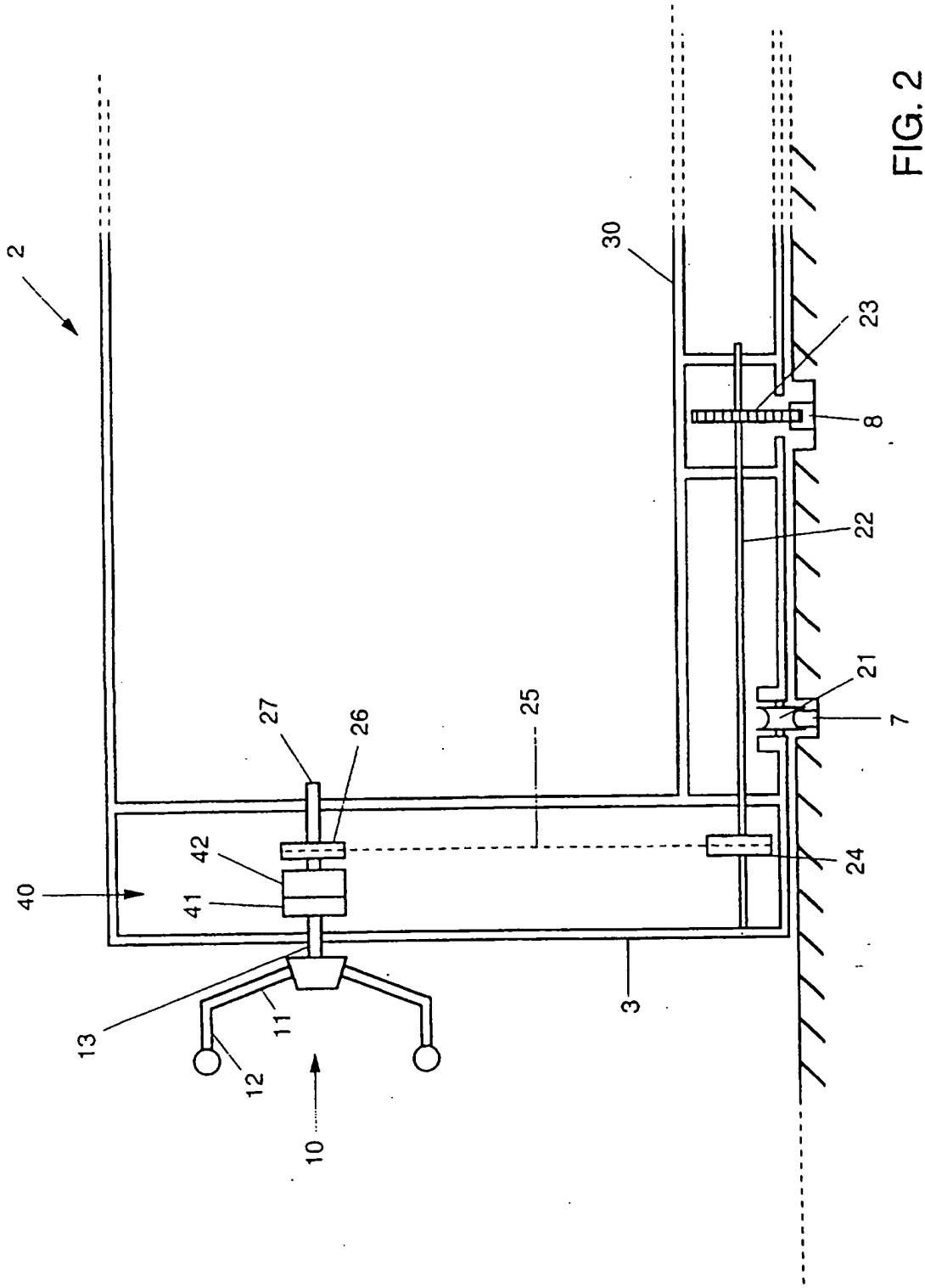


FIG. 2

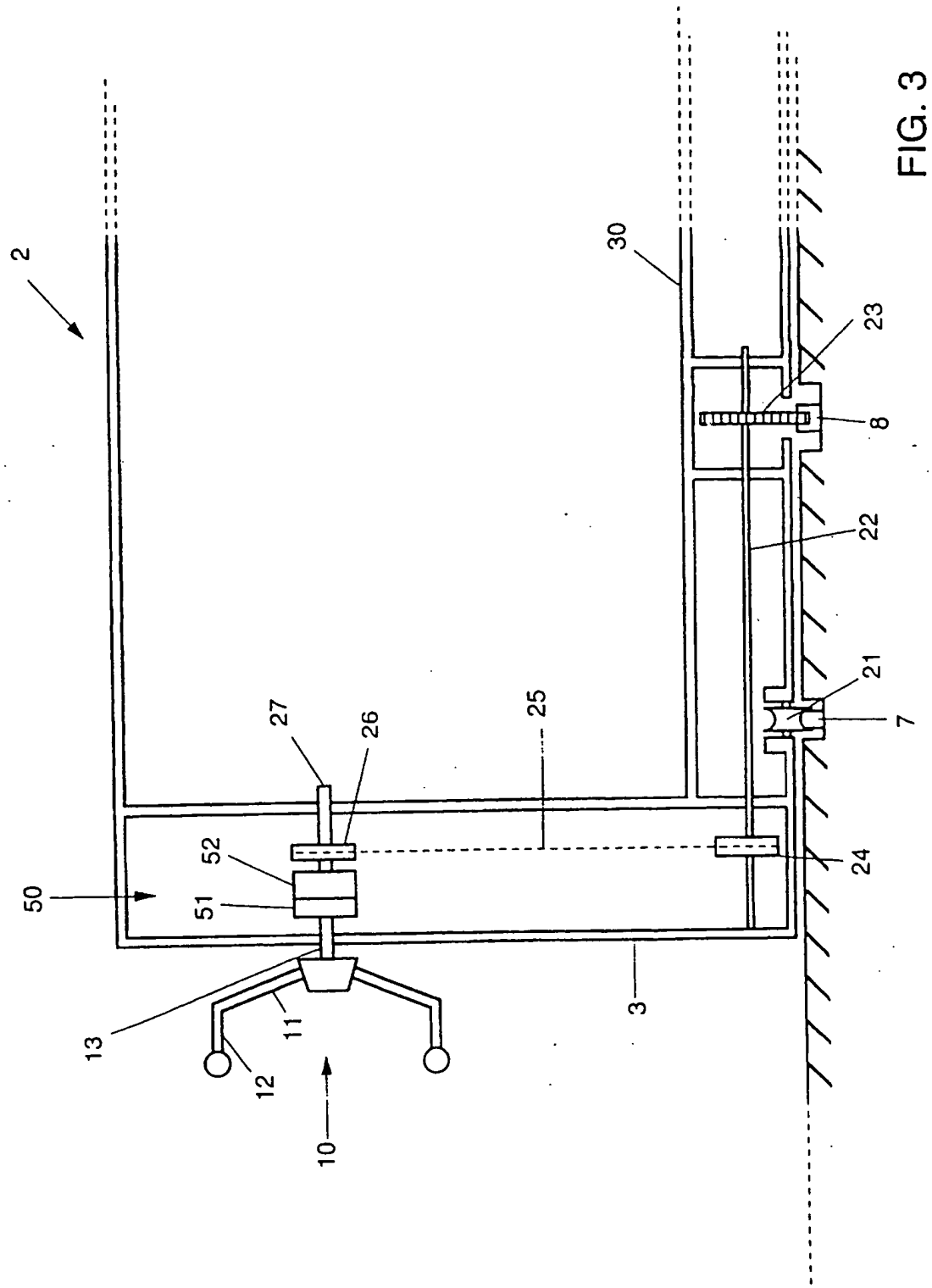


FIG. 3

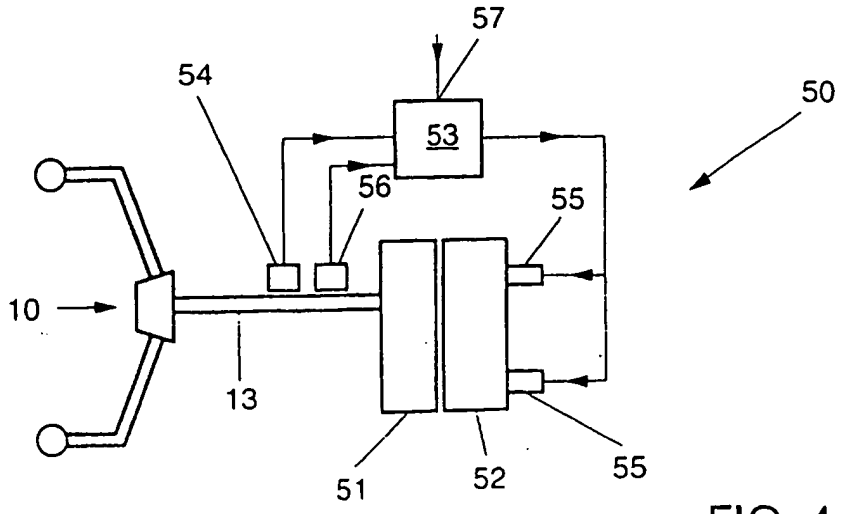


FIG. 4

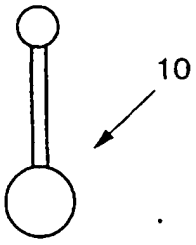


FIG. 5A

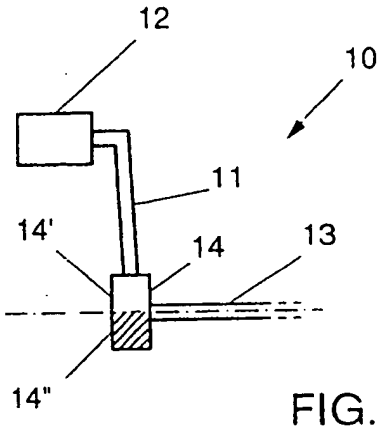


FIG. 5B

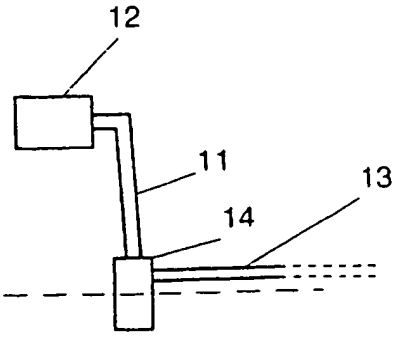


FIG. 5C

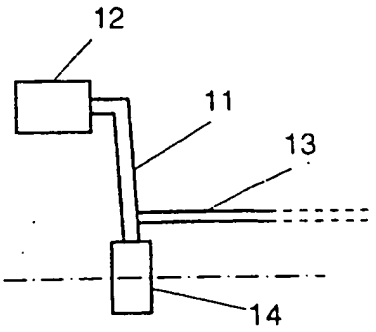


FIG. 5D

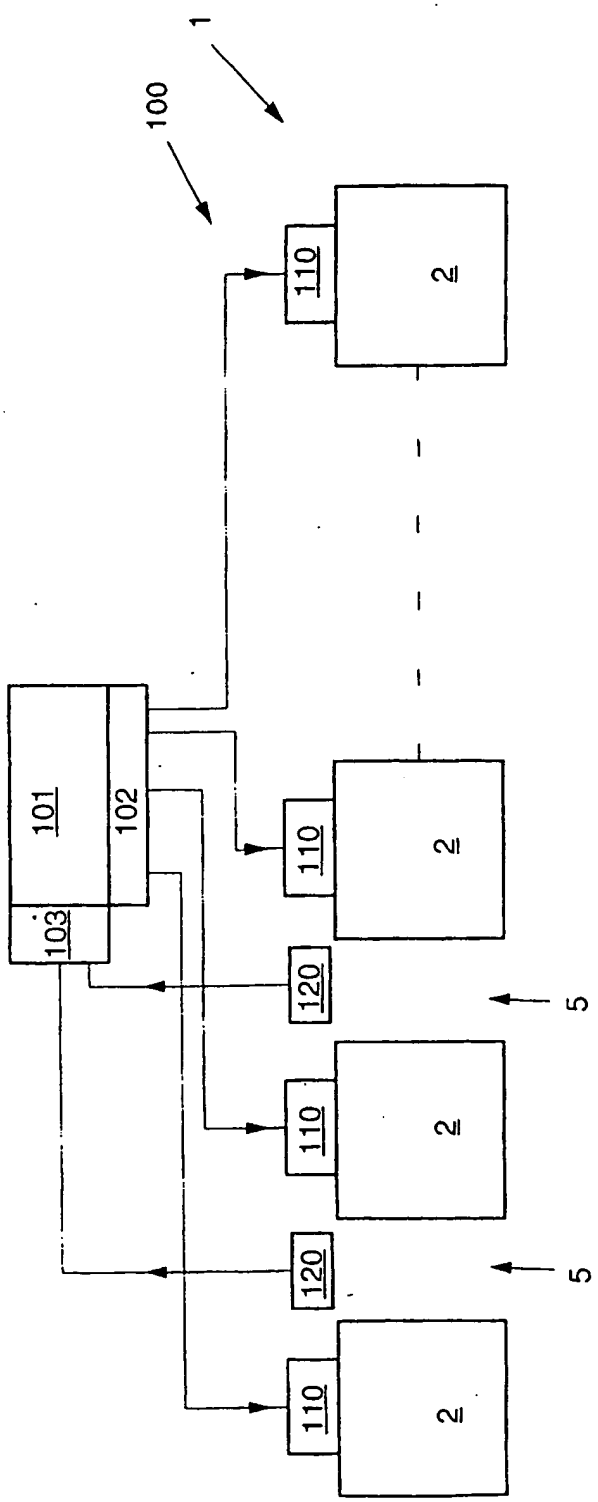
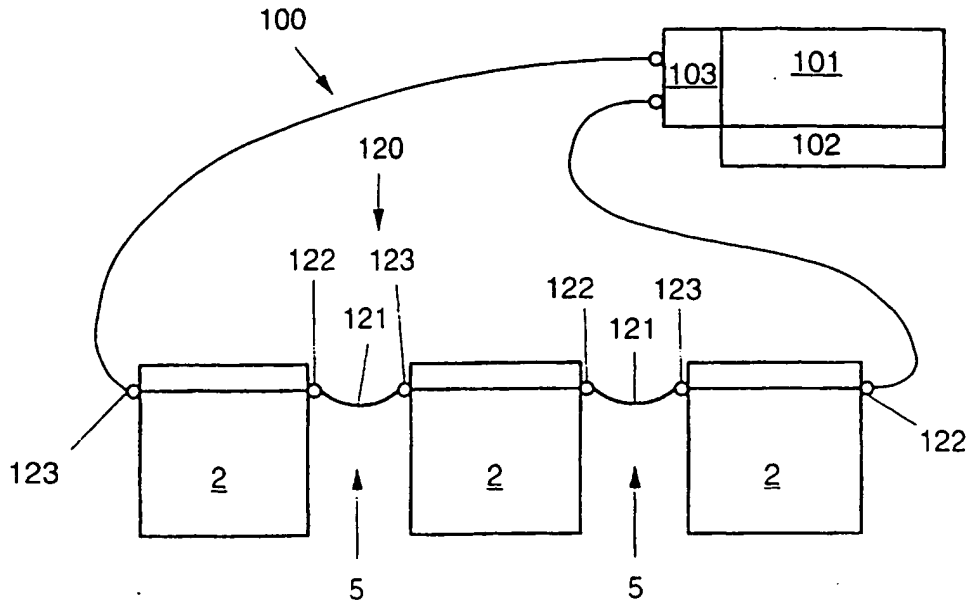


FIG. 6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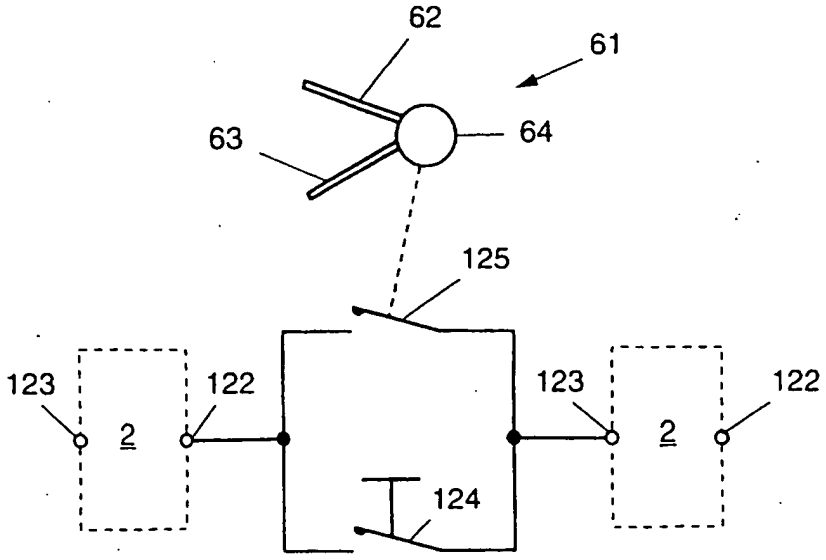
5
5

FIG. 7


62
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2
2
124

FIG. 8

INTERNATIONAL SEARCH REPORT

Interna l Application No
PCT/NL 97/00369

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A47B53/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A47B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 18 07 261 A (FA. OTTO KIND GMBH.) 27 May 1970 see page 3, last paragraph - page 4, paragraph 2; figures 1-3 see page 9, last paragraph ---	14-17
A	US 5 160 189 A (JOHNSTON ET AL.) 3 November 1992 see abstract; figures 1-9 see column 3, line 44 - column 5, line 55 ---	1,4,5, 14,20,25
A	DE 12 82 891 A (HERBERT ZIPPEL K.G.) 15 April 1965 see claims 5-7; figures 1,2 ---	1,25
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 September 1997	28. 10. 97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Jones, C

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	EP 0 043 357 A (ELECTROLUX CONSTRUCTOR AKTIEBOLG) 6 January 1982 see the whole document	14
A	US 5 133 265 A (LAHTI ET AL.) 28 July 1992 see abstract; figures 1-3	21

INTERNATIONAL SEARCH REPORT

Information on patent family members

Internat Application No
PCT/NL 97/00369

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